Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-SI-06
Structural Integrity Categorisation and Classification

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Structural Integrity	-	5	0

GDA ISSUE:	Provide evidence to show that categorisation and classification has been applied in an appropriate manner to components with an important structural integrity claim.
ACTION: GI-AP1000-SI-06.A1	Provide evidence to show that the principal design and construction codes adopted for Class 2 Pressure Equipment and Storage Tanks are consistent with ONR's expectations as detailed within the SAPs, particularly ECS.3 and supporting paragraphs 157-161. In particular, where non-nuclear Pressure Equipment and Storage Tank design and construction codes are used in the design of Class 2 components Westinghouse will need to fully justify each case to show the arguments and evidence which support the use on non-nuclear codes. The arguments and evidence should take account of: • the safety significance of the component; • the demands that are placed on the system in terms of loadings, fatigue, temperature etc, and; • the consequences of failure of pressure boundary in terms of both the loss of system function and on the Internal Hazards safety case. With agreement from the Regulator this action may be completed by alternative means.
ACTION: GI-AP1000-SI-06.A2	Provide evidence to show that components in **AP1000®** Equipment Class C have been assigned a class that is consistent with their intended duty and implied reliability. In particular Westinghouse need to provide arguments and evidence to show why it is appropriate to design and construct the Accumulator Tanks in the Passive Core Cooling System to ASME III Class 3 when previous designs of reactor would have designed and constructed the Accumulators to ASME III Class 2 in line with the guidance provided in ANS-51.1-1983. The arguments and evidence should address: • the intended duty and implied reliability of the vessel, and; • provide evidence to justify why the **AP1000** design has apparently downgraded the classification of the core cooling system from the criteria set in

	ANS-51.1-1983. With agreement from the Regulator this action may be completed by alternative means.
ACTION: GI-AP1000-SI-06.A3	Provide arguments and evidence to show that catastrophic failure of a reactor coolant pump bowl would not challenge the effectiveness of the vertical support for the Steam Generator. The reactor coolant pump bowl has been assigned a Standard Class 1 structural integrity classification. It will be designed and constructed to ASME III, but this is not sufficient in its own right to discount the possibility of gross failure. As a result it is necessary to address the consequences of failure of the pump bowl. Due to the proximity of the reactor coolant pump bowl to the Steam Generator vertical support it is not obvious that failure of the support can be discounted as not credible without sufficient evidence. Thus Westinghouse will need to provide the evidence that the effectiveness of the Steam Generator vertical support will not be challenged by the failure of the pump bowl in order to support the assignment of a Standard Class 1 structural integrity classification for the pump bowl. With agreement from the Regulator this action may be completed by alternative means.
RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE	
Technical Queries	TQ-**AP1000**-1045
Regulatory Observations	RO-**AP1000**-18
Other Documentation	

Scope of work:

The key activities which will need to be completed to close this GDA Issue are:

- Complete the arguments and evidence to support the claim that the appropriate design codes have been selected for UK Class 2 pressure equipment and storage tanks.
- Justify that the components in **AP1000** equipment Class C have been assigned a class that is consistent with their intended duty. This will include justifying that the appropriate ASME classification has been assigned to the accumulators and connected **AP1000** equipment class C components.
- Provide evidence to demonstrate that an assumed failure of the reactor coolant pump (RCP) casing will not have indirect consequences that challenge the effectiveness of steam generator on a best estimate basis as described in UKP-GW-GLR-004.

Description of work:

Action 1

The **AP1000** UK Safety Categorisation and Classification Methodology was revised and submitted in May 2010 following extensive interaction with ONR on the topic. The methodology categorises and classifies systems, structures, and components (SSCs) based on the safety function they perform and the importance they contribute to providing that function. For each classification of equipment, the methodology specifies the design codes and standards used in the design of that equipment. Tables are provided in the methodology that explicitly specifies the codes and standards associated with each Class1, Class 2, and Class 3 SSCs.

In April 2011, ONR raised a new question regarding the design codes and standards associated with UK Class 2 pressure equipment and storage tanks. Due to the late nature of this question inside Step 4 of GDA, Westinghouse was unable to provide a response within the defined Step 4 timeframe. The ONR confirmed that the open question was limited solely to the completion of the justification for the codes and standards used for pressure equipment and storage tanks in Class 2 SSCs.

To resolve this issue, Westinghouse will perform a review of pressure equipment and storage tanks that have been classified as UK Class 2. For systems that contain Class 2 equipment, Westinghouse will justify that appropriate codes and standards have been applied to the pressure equipment and tanks based on their safety significance.

The UK Class 2 components are identified in the **AP1000** UK Safety Categorisation and Classification of Systems, Structures, and Components report. The UK Class 2 pressure equipment and storage tanks are located in systems with relatively low design temperatures and pressures. As defined within the **AP1000** UK Categorisation and Classification Methodology, Category A safety functions are supported by both passive and active equipment. The primary means to accomplish Category A safety functions is using highly reliable passive safety systems designed to nuclear specific codes and standards. The active UK Class 2 systems provide an additional means to accomplish these functions and minimise the need to actuate the passive safety features. The justification will demonstrate that given the robust nature of the **AP1000** passive systems and the absence of a nuclear code written explicitly for Class 2 pressure equipment and storage tanks, it is appropriate to design the Class 2 tanks and pressure equipment to non-nuclear codes and standards with supplemental quality requirements as appropriate. This approach and justification has been used to justify the codes and standards implemented for Class 2 components in other technical areas such as mechanical engineering and civil engineering. Following this approach will provide a consistent implementation for codes and standards for Class 2 components.

Additional supplemental quality requirements are specified for UK Class 2 SSCs which perform defense in depth safety functions. These requirements are highlighted in Section 6.5.2 of the **AP1000** UK Safety Categorisation and Classification Methodology and described in Chapter 17 of the European DCD. The response to this action will further highlight these items to demonstrate additional quality measures are imposed to UK Class 2 components.

Action 2
The **AP1000** accumulators and connected equipment are classified as **AP1000** equipment Class C. In April 2011 ONR inquired why the accumulators were designed according to ASME Code, Section III, Class 3 as opposed to ASME Code, Section III, Class 2 as they are in some existing nuclear power plants. The late nature of this question within the GDA process did not allow Westinghouse an opportunity to provide a response during GDA.

The standard **AP1000** safety classification methodology is provided in Section 3.2 of the European Design Control Document (EDCD), which was provided to ONR during Step 3 of GDA.

In addition to 10 CFR 50.55a, the standard **AP1000** safety classification has been developed considering requirements and guidelines in the following:

- ANSI N18.2 – safety classification
- ANS 51.1 – safety classification
- U.S. NRC Regulatory Guide 1.26 – Quality Groups
- U.S. NRC Regulatory Guide 1.97 – instrumentation requirements
- 10 CFR 21

The specific classifications for various structures, systems, and components included in U.S. NRC Regulatory Guide 1.26, ANSI 18.2, and ANS 51.1 are based on a NPP with active safety systems and are not necessarily appropriate for the passive safety systems of the **AP1000** design. Unlike the current generation of Light Water Reactors, the **AP1000** design uses passive safety systems that rely exclusively on natural forces such as density differences, gravity, and stored energy to provide water and air for core and containment cooling. Recognising this difference, an appropriate classification methodology was developed by Westinghouse that adapted these guidelines for the **AP1000** passive approach to safety. This methodology was reviewed and approved by other international regulatory bodies as part of the **AP1000** standard design approval. In response to this action, Westinghouse will describe these adaptations and justify that they are adequate to provide the required system reliability.

Equipment that is required to provide core cooling in the event of an accident and does not meet the criteria defined for **AP1000** equipment Class A or B is classified as **AP1000** equipment Class C. Class C is a safety related Class equivalent to ANS Safety Class 3. ASME Code, Section III, Class 3 applies to pressure retaining equipment in this class.

Westinghouse will provide an assessment that compares the construction, fabrication, and inspection requirements between **AP1000** Class B and C equipment. The assessment will highlight the consequences of those differences in terms of design margin and worker dose exposure to demonstrate that the appropriate equipment has been assigned to **AP1000** equipment Class C.

Action 3
The **AP1000** RCP casing is manufactured from a single piece forging. The pump casing is welded directly to the bottom of the steam generators (SG) and connected to the

Reactor Coolant System (RCS) cold leg piping. The weld to the SG is assumed to be part of the SG, and the weld to the coolant piping is assumed to be part of RCS piping. Therefore, there are no welds directly associated with the RCP casing.

A UK Structural Integrity Classification Assessment was conducted to determine if there was a need to classify any **AP1000** primary components as either High Safety Significant (HSS) or High Integrity (HI). The assessment is documented in UKP-GW-GLR-004. The assessment considered both the direct and indirect consequences of an assumed gross failure of a defined component. The gross failure was generally considered to be a disruptive failure of the pressure boundary of the component along a defined weld. The weld to the SG was classified as HSS due to potential concerns regarding a gross failure of the weld to the SG channel head could cause a disruptive failure of the channel head which could lead to failure of the vertical support of the SG. The assessment of the RCP primarily focused on the effects of the failure of the pump casing on the surrounding structure. It did not directly consider the effects of a failure of the pump casing on the SG support.

To resolve this action, Westinghouse will expand the assessment to examine the effects of a failure of the casing on the SG support. The first step in the assessment is to determine what are credible fragment sizes for potential missiles resulting from a failure of the RCP casing. Once the potential missile size is determined, a missile impact assessment will be completed that examines the effect of the failure on the SG support. The assessment will be based on the R3 or another equivalent methodology.

The deliverables for Action 1 through Action 3 will be UKP-GW-GL-105, UKP-GW-GL-106, and UKP-GW-GL-107 respectively.

Schedule/ programme milestones:

Please see the following page for the schedule.

Activity Name	2015									2016											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UK Generic Design Assessment (GDA) Resolution Plans (51)																					
STRUCTURAL INTEGRITY																					
SI.06 Categorisation and Classification-Resolution Plan																					
SI.06 UKP-GW-GL-105: AP1000® Plant Review of UK Class 2 Structures, Sys & Components (SSCs) (A1)																					
UKP-GW-GL-105 - Submit to ONR																					
UKP-GW-GL-105 - ONR Review of Submittal																					
UKP-GW-GL-105, Rev 1 - Submit to ONR																					
UKP-GW-GL-105, Rev 1 - ONR Review of Submittal																					
SI.06 UKP-GW-GL-106: Assessment of AP1000® Plant Safety Class B and C (A2)																					
UKP-GW-GL-106 - Submit to ONR																					
UKP-GW-GL-106 - ONR Review of Submittal																					
UKP-GW-GL-106, Rev 1 - Submit to ONR																					
UKP-GW-GL-106, Rev 1 - ONR Review of Submittal																					
SI.06 UKP-GW-GL-107: AP1000® Plant Assessment of Reactor Coolant Pump to Steam Generator Weld (A3)																					
UKP-GW-GL-107 - Submit to ONR																					
UKP-GW-GL-107 - ONR Review of Submittal																					

13-Apr-16

Methodology:

Action 1
Westinghouse will perform a review of systems that contain UK Class 2 SSCs and complete the justification that the codes and standards applied to the pressure equipment and storage tanks are appropriate given their role in supporting their safety functions and the demands the equipment is subjected to.

Action 2
The response will describe why it was necessary to adapt the existing guidance for the **AP1000** plant relative to the codes and standards applied to the standard **AP1000** Class C components. Westinghouse will provide an assessment that compares the construction, fabrication, and inspection requirements between **AP1000** Class B and C equipment and demonstrate that the appropriate ASME Section III classification has been assigned to each **AP1000** component classification. The approach will demonstrate that the applied codes and standards will provide the necessary reliability for the components to perform their required safety functions.

Action 3
R3 or another equivalent methodology.

Justification of adequacy:

Action 1
Please refer to the description of work. The justifications for pressure equipment and tanks classified as UK Class 2 SSCs will complete the demonstration that the appropriate codes and standards have applied to the design of the identified UK Class 2 SSCs. The justification will demonstrate that the appropriate codes and standards have been applied to Class 2 pressure equipment and storage tanks to allow them to reliably perform their intended functions relative to the overall **AP1000** approach to safety. This is the same approach as what has been used for the justification for the codes and standards used for Class 2 components in other GDA review areas such as mechanical engineering and civil engineering. This provides confidence that a successful resolution will be reached following this approach.

Action 2
Please refer to the description of work. The response will demonstrate that the standard **AP1000** safety classification methodology for equipment Class C components is appropriate considering the differences in design margin and worker dose exposure compared to the design standards used for **AP1000** equipment Class B components. The response will demonstrate that adaptations of the existing historical guidance for classification of standard **AP1000** Class C SSCs is appropriate.

Action 3
Please refer to the description of work. The proposed evaluation will demonstrate that missiles generated assuming a gross failure of the RCP casing should not lead to significant core damage and containment failure.

Timely closure of the actions defined in this Issue will be reached through maintaining

quality interaction with ONR and using existing processes to assure closure of open items.

Impact assessment:

The Safety Submission Documents (Pre-Construction Safety Report (primarily Chapter 20), Environment Report and its supporting documents, Design Reference Point, Plant Life Cycle Safety Report, Master Submission List and Roadmap) will be updated as appropriate.